

WHAT IS CLAIMED IS:

1. A confocal endoscope or microscope including:
a light source of coherent light for illuminating a
sample;
a beam splitter; and
light receiving means, wherein an incident beam of
light from said light source is directed onto said beam
splitter and hence onto said sample, and light returning
from said sample and incident on said beam splitter is
deviated or displaced by said beam splitter by a small
angle or distance relative to said incident beam, and
received by said light receiving means located to receive
said returning light and near said light source.
2. A confocal endoscope or microscope as claimed in claim
1, including an optical head and said light source is
located in or on said head.
3. A confocal endoscope or microscope as claimed in claim
2, including heating means for maintaining said head at a
temperature substantially equal to that of said sample.
4. A confocal endoscope or microscope as claimed in claim
1, wherein said light source and said light receiving
means are on a single mounting means.
5. A confocal endoscope or microscope as claimed in claim
4, wherein said beam splitter is mounted on said mounting
means.
6. A confocal endoscope or microscope as claimed in claim
4, wherein said mounting means is moveable for scanning
said light source.
7. A confocal endoscope or microscope as claimed in claim
4, wherein said mounting means includes a reed.

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8. A confocal endoscope or microscope as claimed in claim 4, wherein mounting means is an electromagnetically vibrated reed.

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9. A confocal endoscope or microscope as claimed in claim 1, wherein said light source and said light receiving means are adjacent or touching.

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10. A confocal endoscope or microscope as claimed in claim 1, wherein said light source is an optical fibre tip.

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11. A confocal endoscope or microscope as claimed in claim 1, wherein said beam splitter includes a plurality of prisms and/or lenses.

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12. A confocal endoscope or microscope as claimed in claim 11, wherein said plurality of prisms and/or lenses provide minimal net deviation or translation, so that said coherent light or light reflected from said sample emerges from said plurality of prisms and/or lenses substantially parallel to and optically coaxial with its path immediately before impinging said plurality of prisms and/or lenses.

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13. A confocal endoscope or microscope as claimed in claim 11, wherein said plurality of prisms and/or lenses is arranged to focus confocal return stokes fluorescence to form a line, said line forming a spectrum in which shorter wavelength fluorescence is located towards a first end of said line closer to said light source, while longer wavelength fluorescence is located towards a second end further from said light source.

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14. A confocal endoscope or microscope as claimed in claim 1, including means to allow light on either side of

a spectral line in said returning light to be included with light from said spectral line when said returning light impinges on said light receiving means.

- 5 15. A confocal endoscope or microscope as claimed in claim 14, wherein said means is controlled by a mechanism which occludes light which is more distant in wavelength than a desired amount from said spectral line, to allow control of depth of field isolation.
- 10 16. A confocal endoscope or microscope as claimed in claim 1, including optical elements to divert chosen wavelength portions of said spectral line, and optionally light close in wavelength to said spectral line, to one or
- 15 more photodetectors to give different spectral channels for imaging.
17. A confocal endoscope or microscope as claimed in claim 1, including at least one optical waveguide channel to convey said returning light to said photodetectors.
- 20 18. A confocal endoscope or microscope as claimed in claim 1, including a laser and an optical waveguide to convey light from said laser to said light source.
- 25 19. A confocal endoscope or microscope as claimed in claim 1, including a first optic waveguide to convey light to said specimen and at least one second optic waveguide channel to convey said returning light to said
- 30 photodetectors, and said beam splitter is disposed in said head between said first and second optic waveguides.
- 35 20. A confocal endoscope or microscope as claimed in claim 1, including a return fibre and wherein said beam splitter is located between a light exit area of said return fibre and said photodetectors, to provide spectral separation after said returning light exits said fibre.

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21. A confocal endoscope or microscope as claimed in claim 1, including an aperture slit moveable in front of said photodetectors simultaneously with said scanning to compensate for changes in beam splitter deviation.

22. A confocal endoscope or microscope as claimed in claim 11, wherein said plurality of prisms and/or lenses include at least one apochromatic lens.

23. A confocal endoscope or microscope as claimed in claim 11, wherein said prisms and/or lenses include an SF 11 or SF 59 prism.

24. A method for performing confocal endoscopy or microscopy including:

illuminating a sample by means of an incident or excitatory beam of coherent light; and

deviating or displacing light returning from said sample by a small angle or distance relative to said incident beam.

25. A method as claimed in claim 24, including receiving or detecting said returning light at a point close to a source of said incident or excitatory beam.

26. A method as claimed in claim 24, wherein said deviating or displacing of said light returning from said sample is effected by means of a beam splitter.

27. A confocal endoscope or microscope including:
a light source of coherent light for illuminating a sample;

a beam splitter; and

light receiving means, wherein an incident beam of light from said light source is directed onto said beam splitter and hence onto said sample, and light returning

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from said sample and incident on said beam splitter is deviated by said beam splitter by a small angle relative to said incident beam, and received by said light receiving means located to receive said returning light and near said light source, and said beam splitter includes polarisation rotating means and deviation means to separate light of different polarisations, and operates by optically rotating said coherent light and said returning light.

28. A confocal endoscope or microscope as claimed in claim 26, wherein said polarisation rotating means is based on optical rotary dispersion and includes a chiral medium to optically rotate said coherent light and said returning light.

29. A confocal endoscope or microscope as claimed in claim 27, wherein said polarisation rotation means includes a Faraday effect material, said material having simultaneously magnetic lines of force in the same direction as the propagation direction of said light, whereby the E vector of said coherent light is rotated as it passes through said material .

30. A confocal endoscope or microscope as claimed in claim 27, wherein said polarisation rotation means includes phase plates or retardation elements, of a material whose structure is anisotropic at a molecular or crystalline level.

31. A confocal endoscope or microscope as claimed in claim 27, wherein said polarisation rotation means includes liquid crystals.

32. A confocal endoscope or microscope as claimed in claim 31, wherein said liquid crystals are optically active and/or birefringent.

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33. A confocal endoscope or microscope as claimed in claim 31, wherein said liquid crystals are cholesteric liquid crystals.

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34. A confocal endoscope or microscope as claimed in claim (25), wherein said optical rotation is provided by intrinsic polarisation properties of the sample or of any intermediate optical medium.

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35. A method for maintaining registration in a confocal endoscope or microscope including a light source and a light receiving means, including:

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splitting light returned from a sample with a small angle deviation beam splitter;

employing said light source and said light receiving means located on a single moveable mounting means;

moving said mounting means to scan said light source and thereby said sample.

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36. A method as claimed in claim 35, wherein said beam splitter includes a plurality of prisms and/or lenses.

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37. A method as claimed in claim 36, wherein said plurality of prisms and/or lenses provide minimal net deviation.

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38. A method as claimed in claim 36, including moving said beam splitter with said light source and said light receiving means.

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39. A method as claimed in claim 35, wherein said moving of said mounting means comprises vibrating said mounting means.

40. A method as claimed in claim 35, wherein said mounting means is a reed.

41. A method as claimed in claim 35, wherein said mounting means is an electromagnetically vibrated reed.

5 42. A confocal endoscope or microscope as claimed in claim (1), wherein said light source comprises a mirror located in the path of the returning light for directing light towards said sample, wherein said mirror has a smaller solid angle than said returning light to only
10 partially occlude reception of said returning light by said light receiving means.

43. A confocal endoscope or microscope as claimed in claim 42, wherein said mirror and said light source are
15 provided on a single piece of silicon and said mirror comprises an etched mirror surface of the silicon.

44. A method for performing confocal endoscopy or microscopy including:
20 illuminating a sample by means of an incident or excitatory beam of coherent light and thereby inducing a broader beam of returning light; and
detecting a portion of said returning light adjacent to or near said incident beam.

25 45. A method as claimed in claim 44, including directing said incident light towards said sample by means of a mirror located in the path of said returning light, wherein said mirror has a smaller solid angle than said
30 returning light to only partially occlude reception of said returning light.

46. A method as claimed in claim 45, wherein said mirror and the source of said incident light are provided on a
35 single piece of silicon and said mirror comprises an etched mirror surface of the silicon.

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